Space Weather Technical Forecast

From the 24th of September, the way we distribute this forecast is changing and you will need to take action to continue receiving it. You should have received an email on the 4th of September explaining the steps required to do this. If you have already signed up to receive the forecast on our premium website, please disregard this message. If you haven't, or if you need help with the process, please contact moswoc@metoffice.gov.uk.

Issued on Monday, 09 September 2024 at 13:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares remain likely throughout. A glancing CME could give a chance of G1-G2 Minor-Moderate Storms on Day 2 or 3 (10-11 Sep). Chance of S1 Minor Radiation storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity is Moderate with a peak flare of M1.8 at 09/0545UTC from AR3806 near the southwest limb, which has recently rotated off the disc. There are twelve sunspot regions on the disc. A broad complex of small spots in the south-centre disc have been assessed as four regions AR3813, AR3815, AR3819 and AR3820, although SDO imagery continue to hint at some connection between these regions, along with a line of filaments that continue back to AR3811. These spots are relatively simple, with limited areal extent, and some sign of weakening, however given a history of notable flaring and the overarching magnetic field, further development or activity cannot be ruled out. AR3814 in the northeast still consists of a weak and tenuous delta spot in its trailing portion. AR3808 is difficult to assess now it's located on the west limb, which will rotate off soon. AR3821 in the northwest has seen smaller spots consolidating into two larger spots. The remaining spot regions are generally small and stable.

AR3806 has rotated off the west limb, although continues to produce M-class flares, with a longevity M1 flare observed early on 09 Sep, which produced a CME off the west limb, which is not considered Earth-directed. This activity recently produced an S1 minor solar radiation storm.

A full halo CME was observed 09/0500 UTC off the far-side of the Sun, which is likely associated with an eruption seen just beyond the east limb. This is yet to be analysed, although unlikely to have any Earth-directed component.

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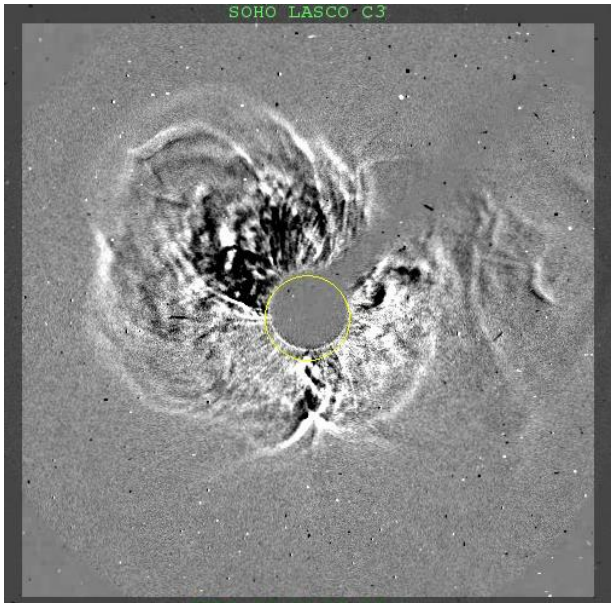
Figure 0. SOHO LASCO C3 shows far-sided full halo CME.



No Earth-directed CMEs have been observed during the period.

Solar Wind / Geomagnetic Activity: Slow wind conditions persisted at L1 with observed solar wind speeds by ACE and DSCOVR generally at slow-ambient levels, between 330 and 390km/s. However, solar winds briefly reached just above 400km/s (slightly elevated), possibly due to a weak connection with CH65/+, early on 09 Sep. Density was mostly below average. Interplanetary Magnetic Field, Bt, was Weak to Moderate, in the range 7-12nT, with north-south component, Bz, variable in direction and in the range -8nT to +12nT. Phi angle was mostly negative (towards the Sun), with brief re-orientation to positive (away from the Sun), which may have been the result of a weak connection to CH65/+. Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 continued at slightly elevated levels, before briefly reaching the S1 Minor Radiation threshold at 09/0850UTC due to a longevity M-class flare from AR3808 just beyond the west limb. High energy electron flux (greater than 2MeV) observed by GOES16 was mainly Background to Moderate. The associated 24-hour fluence remained below the Active threshold, with 3.41e6 integrated pfu observed at 08/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with M-flares likely through the period, but with a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: A possible HSS from CH65/+ may have briefly materialised early on 09 Sept, but is unlikely to have any impact on geomagnetic activity. CME influences from a large filament eruption on 08 Sep are likely to give a glancing blow at Earth late on Day 2 (10 Sep) or early on Day 3 (11 Sep).

Overall, generally Quiet (Kp1-2) to Unsettled (Kp3) geomagnetic activity is expected on Day 1 (09 Sep). Late on Day 2 (10 Sep), or early on Day 3 (11 Sep), a glancing blow from the filament eruption CME is likely, with a chance of G1-G2/Minor-Moderate Storm levels (Kp5-6) being reached. The effects of this CME may linger on into Day 4 (12 Sep), but likely at a reduced level.

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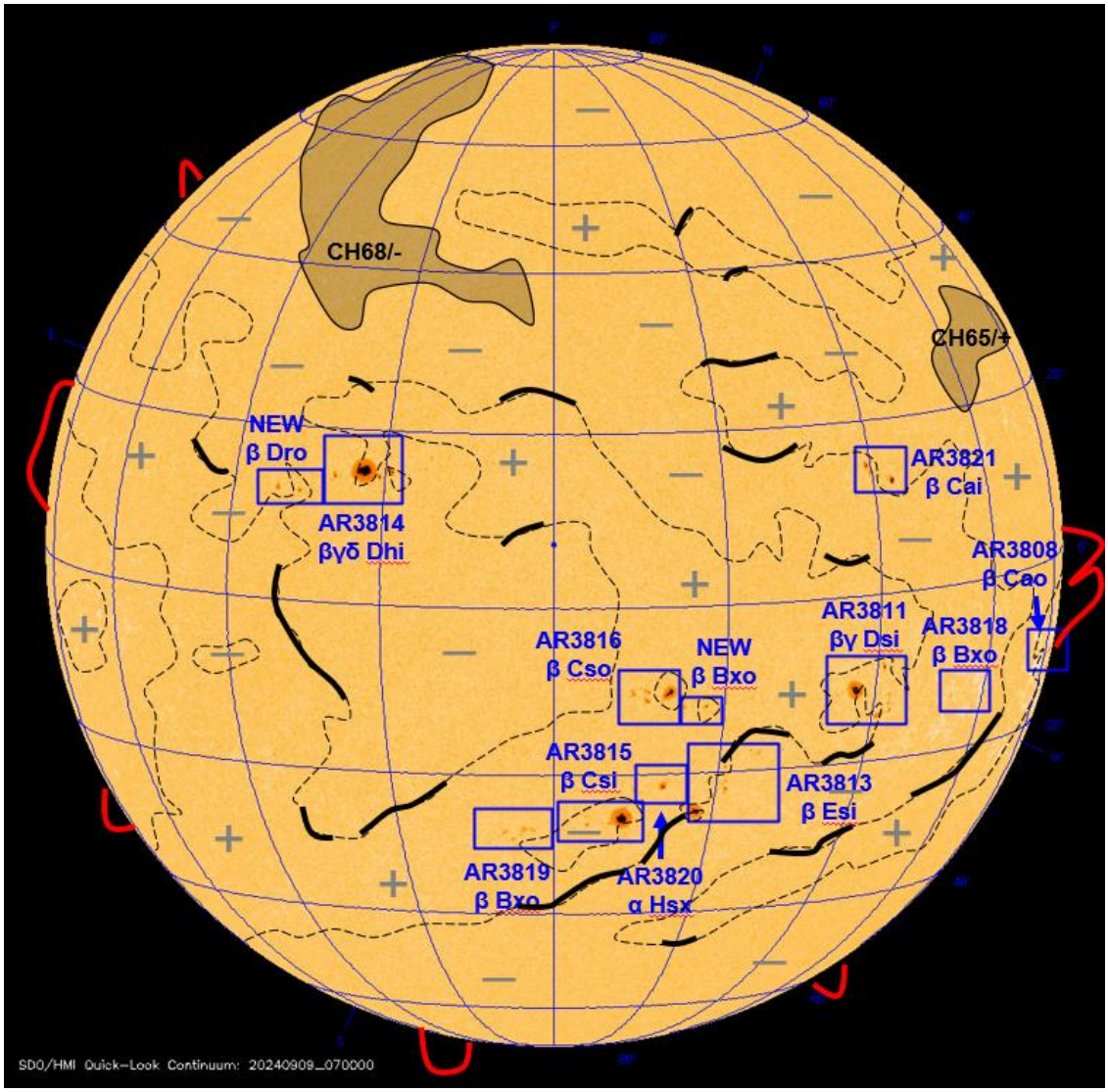
Energetic Particles / Solar Radiation: High energy proton flux may continue to be slightly elevated at first, before easing towards background levels. However, there remains a slight chance of further enhancements from any notable flares, the risk increasing slightly as the south-centre regions move across the western disc. High energy electron flux is expected to be Background to Moderate levels The associated electron fluence is expected to stay below Active.

Figure 1. Solar Analysis Valid 09/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Slow wind conditions expected at first. We may have seen a brief increase in the solar winds early on 09 Sep, reaching just above 400km/s (slightly elevated), probably due to a weak connection to CH65/+, although speeds quickly reduced back to slow-ambient levels.

A CME from the filament eruption that occurred early on 08 Sep is likely to give Earth some glancing influence, either late on Day 2 (10 Sep) or early on Day 3 (11 Sep), with the bulk of its ejecta expected to pass ahead of Earth's orbit. The arrival of this glancing CME could give the chance of a G1-G2/Minor-Moderate Storm, especially if it is a more direct hit.

In summary, generally Quiet (Kp1-2) to Unsettled (Kp3) geomagnetic activity is expected at first. Late on Day 2 (10 Sep), or early on Day 3 (11 Sep), a glancing blow from the filament eruption CME is likely, with a chance of G1-G2/Minor-Moderate Storm levels (Kp5-6) being reached. The effects of this CME may linger on into Day 4 (12 Sep), but likely at a reduced level.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	40	10
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
08/0525 UTC	Partial	Filament	NW	700 km/s	11/0000UTC +/- 12hrs	Glancing blow likely

Figure 2: MOSWOC Enlil and Ensemble models showing possible CME arrival time.

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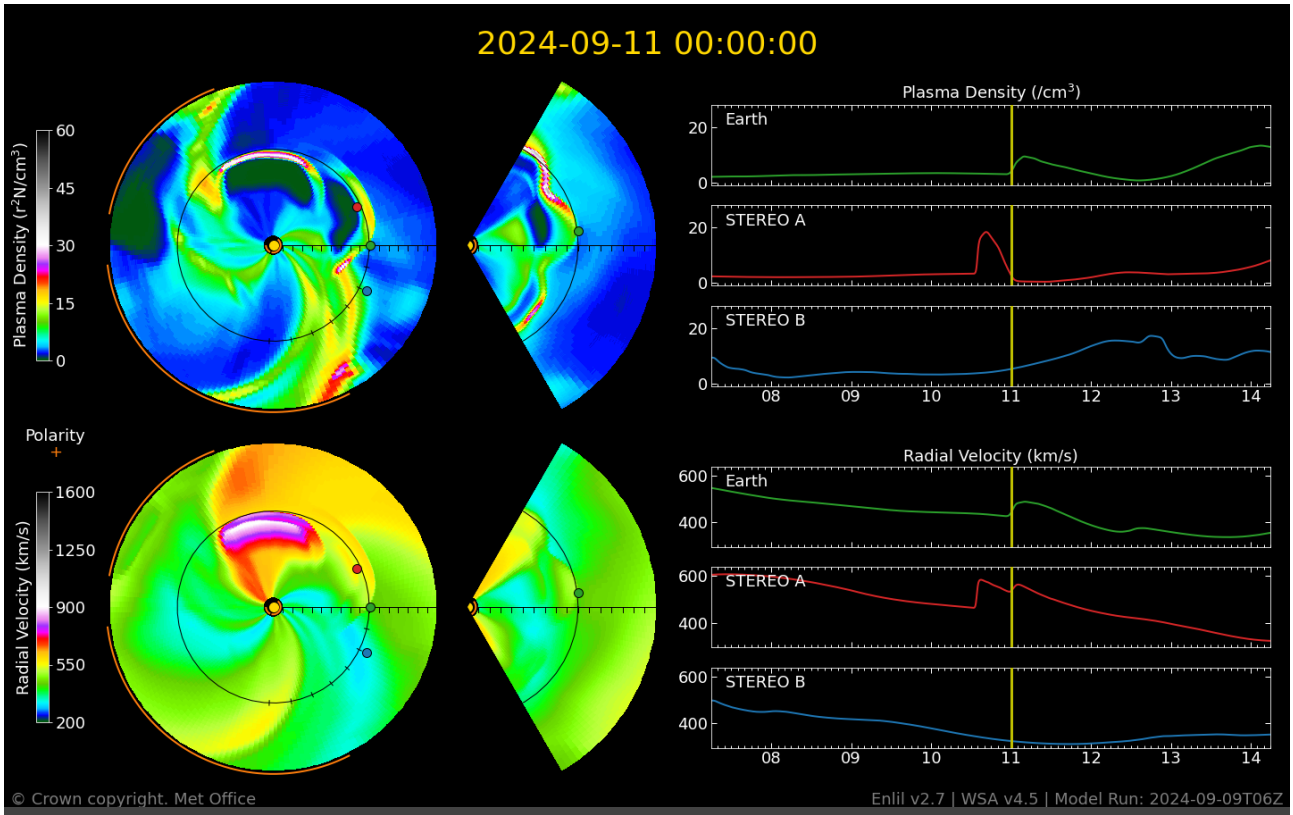
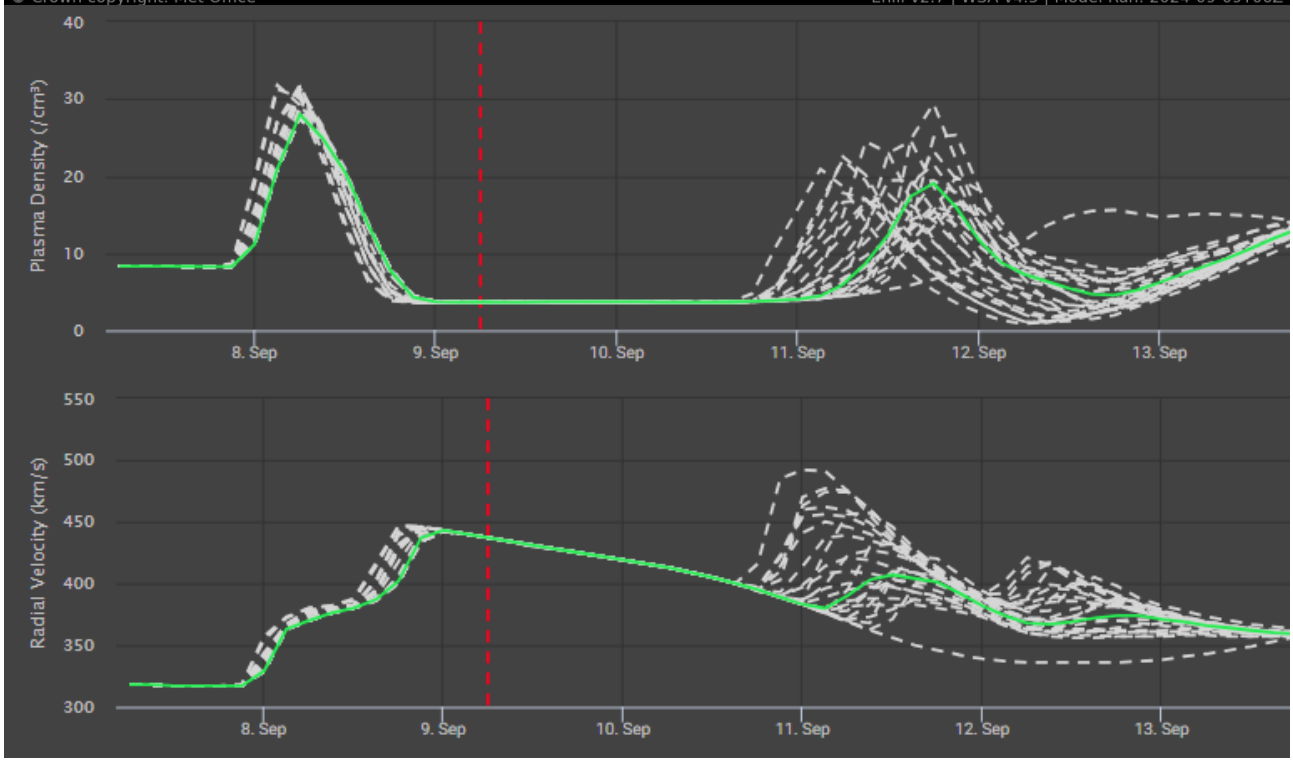
Space Weather Technical Forecast





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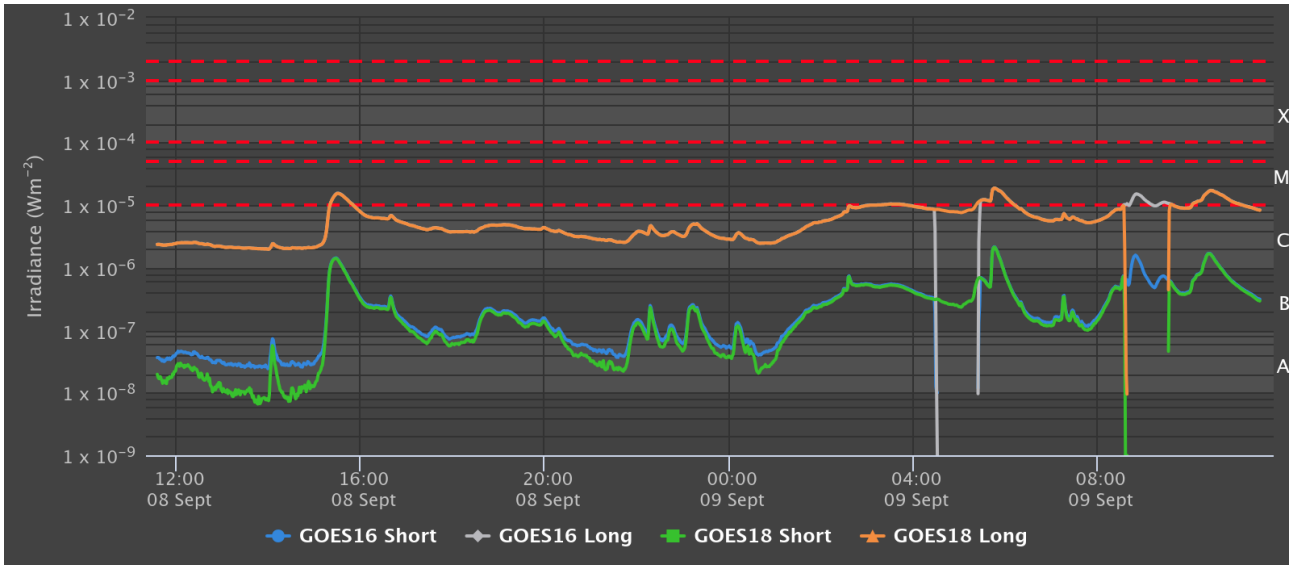
Radio Blackouts - X-Ray Flares:
Activity is Moderate with a peak flare of M1.8 at 09/0545UTC from AR3806 near the southwest limb, which has recently rotated off the disc. Moderate activity is forecast with further M-class flares likely, and a slight chance of an isolated X-class flare.

There are twelve sunspot regions on the disc. A broad complex of small spots in the south centre disc have been assessed as four regions AR3813, AR3815, AR3819 and AR3820, although SDO imagery continue to hint at some connection between these regions, along with a line of filaments that continue back to AR3811. These spots are relatively simple, with limited areal extent, and some sign of weakening, however given a history of notable flaring and the overarching magnetic field, further development or activity cannot be ruled out. AR3814 in the northeast still consists of a weak and tenuous delta spot in its trailing portion. AR3808 is difficult to assess now it's located on the west limb, which will rotate off soon. AR3821 in the northwest has seen smaller spots consolidating into two larger spots. The remaining spot regions are generally small and stable.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	60	60	60	60
Very Active	**R3 to R5 X Class**	No	10	10	10	10

Figure 3: GOES16/18 X-Ray flux trace.



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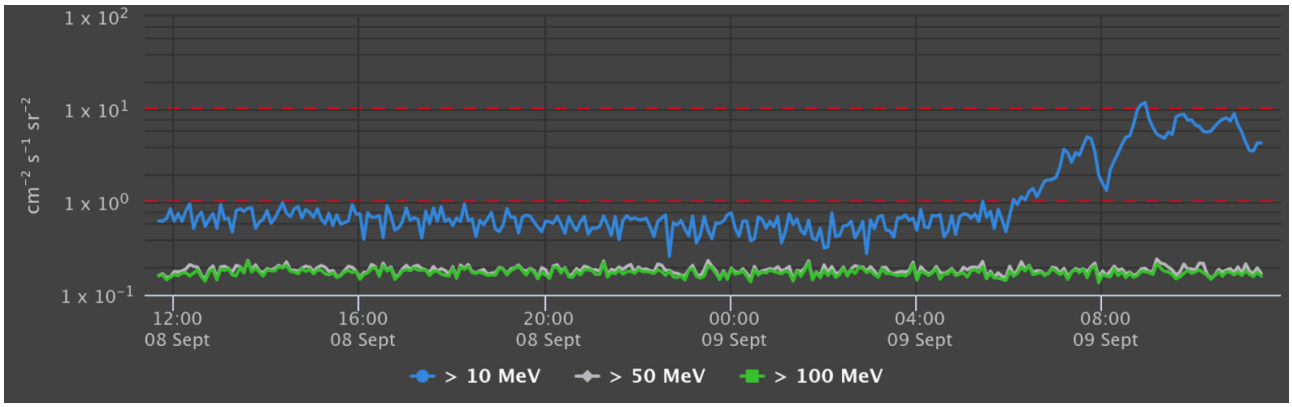
Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18 briefly exceeded the S1 Minor Radiation Storm threshold at 09/0850UTC due to a longevity M-class flare from AR3808, which is located just beyond the west limb. Proton flux levels are likely to stay slightly elevated with a gradual decline towards background levels.

Further chance of reaching the S1 Minor Radiation Storm threshold in the coming days, if any other significant flaring occurs from beyond the west limb, although further contributions are likely from sunspot regions currently in the south-centre disc, as these continue to move into the western hemisphere and into a more geoeffective location.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	99	30	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES18 Proton Flux – shows a recent S1 Minor Radiation Storm.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 has been Background to Moderate. Given the expected arrival of a glancing CME later Day 2 or early Day 3, electrons remained suppressed.

Overall, the 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold throughout the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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